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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

IN REPLY
REFER TO: OEA-095 February 4, 1999
MEMORANDUM

SUBJECT: Bunker Hill, CLP Metals Analysis, Data Validation
Case: 26738
SDG: MJAE54

FROM: Laura Castrilli, Chemist
Quality Assurance and Data Unit, OEA

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TO: Mary Kay Voytilla, Regional Project Manager
Office of Environmental Cleanup

CC: Bruce Woods, Region 10 CLP TPO
Jim Stefanoff, CH2M Hill

The following is a validation of ICP-AES and mercury analyses of twenty water samples from the Bunker Hill project. The analyses were performed following the USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis Multi-media, Multi-Concentration, ILM04.0. Analyses were conducted by Sentinel Inc. of Huntsville, Alabama. This validation was conducted for the following samples:

Total (unfiltered) samples:

MJAE54 MJAE55 MJAE56 MJAE57 MJAE58 MJAE59 MJAE60

Dissolved (filtered) samples:

MJAE61 MJAE63 MJAE65 MJAE67 MJAE69 MJAE71 MJAE73
MJAE62 MJAE64 MJAE66 MJAE68 MJAE70 MJAE72

Data Qualifications

The following comments refer to the Sentinel Laboratory's performance in meeting quality control specifications outlined in the *CLP Statement of Work (CLP-SOW) for Inorganic Analysis, rev. ILM04.0.* The comments presented herein are based on the information provided for the review.

1.0 Timeliness - Acceptable

The technical (40 CFR part 136) holding time from the date of collection for mercury in water is 28 days. The holding time for the remaining metals in water is 180 days. The samples were collected

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between 12/16/98 and 12/17/98. Mercury analyses were completed on 12/29/98. ICP-AES analyses were completed on 01/05/99.

2.0 Sample Preparation - Acceptable

The samples were prepared for mercury and ICP-AES analyses on 12/28/98.

3.0 Calibrations/Calibration Verifications - Acceptable

The samples were analyzed for mercury by CVAAS on 12/29/98. Initial calibration included one blank and six standards. The curve was linear with a correlation coefficient greater than 0.995.

The samples were analyzed by ICP-AES on 12/30/98 (main analyses), 12/31/98 (some lead, potassium, selenium, silver and zinc analyses), 01/03/99 (ten fold dilutions for iron, manganese, sodium, and/or zinc in a number of samples), and 01/05/99 (one hundred fold dilutions for iron and/or zinc in a number of samples and one thousand fold dilutions for zinc in samples MJAE55 and MJAE62). The instrument was standardized according to the analytical method each day of analysis using one blank and a single calibration standard for each element.

All ICP-AES and CVAAS (mercury) calibrations were performed as required and met the acceptance criteria; therefore, no qualification was made on this basis.

Continuing calibration verifications (CCVs) are required before and after sample analysis and after every 10 samples during analysis. Mercury recoveries must be within 80-120%. Other metal recoveries must be within 90-110%. The frequency of analysis of CCVs was met. All ICP-AES and CVAAS (mercury) CCVs (initial and continuing) bracketing reported sample results met the recovery criteria.

4.0 Laboratory Control Samples - Acceptable

Laboratory Control samples are digested and analyzed along with the samples to verify the efficiency of laboratory procedures. All recoveries associated with reported sample results met the acceptance criteria for control samples.

5.0 Blanks -

Procedural blanks were prepared with the samples to show potential contamination from the digestion or analytical procedure. If an analyte was found in the associated blank, the sample results were qualified if the analyte concentration was less than five times the analytical value in the blank.

Arsenic, calcium, iron, and magnesium were detected in the preparation blank. Zinc in the preparation blank had a negative result with an absolute value greater than the detection limit. Aluminum, antimony,

arsenic, calcium, cadmium, copper, iron, magnesium, manganese, potassium, selenium, and zinc were detected in one or more ICP-AES continuing calibration blanks. Some lead and zinc CCBs had negative results with absolute values greater than the detection limits. Based on blank contamination, associated sample results were qualified as follows:

- aluminum in samples MJAE59, MJAE60, and MJAE67 was qualified 'U'
- antimony in samples MJAE54, MJAE70, and MJAE71 was qualified 'U'
- arsenic in samples MJAE59, MJAE64, and MJAE66 was qualified 'U'
- cadmium in sample MJAE57 was qualified 'U'
- selenium in samples MJAE54, MJAE56, MJAE59, and MJAE66 was qualified 'U'

All other sample results were greater than five times the associated blank levels (or were already undetected) and were not qualified based on blank contamination.

6.0 ICP-AES Interference Check Sample -

The interference check sample (ICS) is analyzed by ICP-AES to verify interelement and background correction factors. Analysis is required at the beginning and end of each sample analysis run and recoveries must be between 80% and 120%. All ICS recoveries associated with reported sample results were within the recovery criterion with the exception of the recovery for zinc in the ICS-A analyses on 12/30/98, 12/31/98, and 01/03/99. Zinc results in the associated samples were not qualified due to the following reasons: 1)the recovery for zinc in one or more of the ICS-AB analyses bracketing reported zinc results were acceptable, 2) the associated/reported results in the samples were closer to or higher than the levels in the ICS-AB sample, and/or 3) the samples did not have corresponding interferent levels of interfering analytes.

The raw data for a number of samples had interfering levels of iron. Analytes for which iron is an interferent were qualified as follows:

- Antimony in samples MJAE54, MJAE55, MJAE56, MJAE63, MJAE71, and MJAE73 was qualified 'UJ', estimated detection limit(possible false positives) as antimony in the three ICS-A analyses bracketing these samples had results greater than the detection limit (estimated antimony due to iron was more than 70% of the reported results).
- Selenium in samples MJAE54 and MJAE56 was qualified 'UJ', estimated detection limit (possible false positives) as selenium in the three ICS-A analyses bracketing these samples had results greater than the detection limit (estimated selenium due to iron was more than 70% of the reported results).
- Selenium in samples MJAE61, MJAE62, MJAE63, MJAE68, MJAE69, MJAE71, and MJAE73 was qualified 'UJ', estimated detection limit (possible false negatives) as selenium in the three ICS-A analyses bracketing these samples had negative results with

absolute values greater than the detection limit.

- Vanadium in samples MJAE54, MJAE58, MJAE61, MJAE65, MJAE68, MJAE69, and MJAE71 was qualified 'UJ', estimated detection limit (possible false negatives) as vanadium in the three ICS-A analyses bracketing these samples had negative results with absolute values greater than the detection limit. Vanadium in samples MJAE55, MJAE56, MJAE62, MJAE63, and MJAE73 was not qualified as 100 fold dilutions were performed on these samples and an examination of the data showed no suppression of vanadium due to high iron.

Some of the samples required multiple dilution runs to report zinc, iron, manganese, and sodium results within the instrumental linear range. The raw data for all analytes were compared using the available dilutions to see if 1) zinc, iron, sodium, and/or manganese levels in the undiluted samples were high enough that interelement corrections may not be sufficient for the analytes that were reported from the undiluted analyses or 2) a pattern of suppression or enhancement was evident.

From this comparative study, the following results were qualified due to suspected interference:

- Aluminum, arsenic, beryllium, calcium, cadmium, cobalt, copper, magnesium, nickel, silver, selenium, and thallium were qualified 'J', estimated or 'UJ' estimated detection limit (pattern of suppression/possible low bias or false negative) in samples MJAE55 and MJAE62.
- Sodium was qualified 'J', estimated (pattern of enhancement/possible high bias) in samples MJAE55, MJAE56, MJAE62, MJAE63, and MJAE73.
- Manganese was qualified 'J', estimated (possible severe low bias) as the undiluted analyses were within the linear range, the ten fold dilutions were outside the linear range, the 100 fold dilutions showed considerably higher manganese results than the undiluted analyses (difference of around a factor of 60), and the lab reported the results from the un-diluted analyses in samples MJAE55 and MJAE62.

7.0 Duplicate Analysis - Acceptable

Duplicate analyses were done on dissolved sample MJAE66 and total sample MJAE59. Water duplicate results were within the ±20% Relative Percent Difference (RPD) or ±CRDL criteria for water results < 5 times the CRDL criteria. No qualification was made on this basis.

8.0 Field Duplicate Analysis - Not Applicable

Field duplicate analysis for samples in this SDG was not indicated in the field collection documentation.

9.0 Matrix Spike Analysis - Acceptable

Matrix spike sample analyses are done to provide information about the effect of the sample matrix on digestion and measurement methods. Matrix spike recovery must be within the limits of 75 - 125%.

Matrix spike analyses were done on dissolved sample MJAE66 and total sample MJAE59. All matrix spike recoveries were within the required QC limits. No qualification was made on this basis.

10.0 Graphite Furnace Atomic Absorption Spec (GFAAS) QC - Not Applicable -

GFAAS was not used for the analysis of these samples.

11.0 ICP-AES Serial Dilution - Acceptable

Dissolved sample MJAE66 and total sample MJAE59 were analyzed by ICP-AES serial dilution to check for potential interferences. All analytes which exceeded the minimum concentration criterion (50 times the IDL) agreed within the 10%D criteria. No qualification was made on this basis.

12.0 Detection Limits - Acceptable

Sample results which fall below the instrument detection limit (IDL) are assigned the value of the instrument detection limit and the 'U' qualifier is attached. Contract Required Detection Limit (CRDL) standards are required to demonstrate a linear calibration curve near the CRDL. CRDL standards were run at the required frequency.

13.0 Overall Assessment of the Data

This validation of the data is based on the criteria outlined in the *National Functional Guidelines for Inorganic Data Review (02/94)*. Approximately 14% of the data was qualified based on blank contamination and/or interference. The data as qualified is acceptable for all purposes. Note that some zinc results were hand recorded by a laboratory employee on the Form's 1. Occasionally, the hand recorded results do not line up exactly with zinc and look more like cyanide results. However, the hand recorded results between zinc and cyanide are actually zinc results.

Below are the definitions for the National Functional Guidelines for Inorganic Data Review (02/94) qualifiers used when validating/qualifying data from Inorganic analysis.

DATA QUALIFIERS

U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is

either the sample quantitation limit or the sample detection limit.

J - The associated value is an estimated quantity.

R - The data are unusable. (Note: Analyte may or may not be present.)

UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE54

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17268S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5860			P
7440-36-0	Antimony	6.0	~~B~~	UJ	P
7440-38-2	Arsenic	151			P
7440-39-3	Barium	11.3	B		P
7440-41-7	Beryllium	2.5	B		P
7440-43-9	Cadmium	402			P
7440-70-2	Calcium	29500			P
7440-47-3	Chromium	1.3	B		P
7440-48-4	Cobalt	123			P
7440-50-8	Copper	308			P
7439-89-6	Iron	203000			P
7439-92-1	Lead	360			P
7439-95-4	Magnesium	53200			P
7439-96-5	Manganese	40800			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	109			P
7440-09-7	Potassium	1030	B		P
7782-49-2	Selenium	3.5	~~B~~	UJ	P
7440-22-4	Silver	15.3			P
7440-23-5	Sodium	1850	B		P
7440-28-0	Thallium	22.9			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc	204000			P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE55

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17269S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	218000		J	P
7440-36-0	Antimony	196		UJ	P
7440-38-2	Arsenic	7640		J	P
7440-39-3	Barium	18.3	B		P
7440-41-7	Beryllium	37.1		J	P
7440-43-9	Cadmium	10100		J	P
7440-70-2	Calcium	147000		J	P
7440-47-3	Chromium	15.8			P
7440-48-4	Cobalt	3220		J	P
7440-50-8	Copper	11200		J	P
7439-89-6	Iron	13200000			P
7439-92-1	Lead	120		J	P
7439-95-4	Magnesium	418000		J	P
7439-96-5	Manganese	35000		J	P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	2550		J	P
7440-09-7	Potassium	150	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	1.1	U	J	P
7440-23-5	Sodium	774000		J	P
7440-28-0	Thallium	407		J	P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	19000000			P
	Cyanide				NR

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INORGANIC ANALYSIS DATA SHEET

MJAE56

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17270S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	28000			P
7440-36-0	Antimony	32.5	~~B~~	UJ	P
7440-38-2	Arsenic	798			P
7440-39-3	Barium	10.4	B		P
7440-41-7	Beryllium	11.0			P
7440-43-9	Cadmium	2530			P
7440-70-2	Calcium	64200			P
7440-47-3	Chromium	10.8			P
7440-48-4	Cobalt	437			P
7440-50-8	Copper	1990			P
7439-89-6	Iron	2130000			P
7439-92-1	Lead	900			P
7439-95-4	Magnesium	141000			P
7439-96-5	Manganese	224000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	416			P
7440-09-7	Potassium	734	B		P
7782-49-2	Selenium	10.5		UJ	P
7440-22-4	Silver	137			P
7440-23-5	Sodium	55600		J	P
7440-28-0	Thallium	170			P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	1290000			P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE57

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17271S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	546			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	27.7			P
7440-39-3	Barium	5.0	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	1.4	~~B~~	U	P
7440-70-2	Calcium	3450	B		P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	7.7	B		P
7440-50-8	Copper	4.5	B		P
7439-89-6	Iron	15000			P
7439-92-1	Lead	27.9			P
7439-95-4	Magnesium	1560	B		P
7439-96-5	Manganese	1750			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	5.5	B		P
7440-09-7	Potassium	722	B		P
7782-49-2	Selenium	1.9	U		P
7440-22-4	Silver	1.4	B		P
7440-23-5	Sodium	597	B		P
7440-28-0	Thallium	3.6	U		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	400.0			~~NR~~ P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE58

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17272S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1380			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	2.0	U		P
7440-39-3	Barium	17.9	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	23.5			P
7440-70-2	Calcium	389000			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	281			P
7440-50-8	Copper	23.4	B		P
7439-89-6	Iron	146000			P
7439-92-1	Lead	746			P
7439-95-4	Magnesium	443000			P
7439-96-5	Manganese	328000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	257			P
7440-09-7	Potassium	18200			P
7782-49-2	Selenium	70.8			P
7440-22-4	Silver	75.3			P
7440-23-5	Sodium	3910	B		P
7440-28-0	Thallium	161			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc	39100			~~NR~~ P
	Cyanide				NR

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INORGANIC ANALYSIS DATA SHEET

MJAE59

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17273S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	104	~~B~~ U		P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	4.6	B		P
7440-39-3	Barium	66.8	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	18.9			P
7440-70-2	Calcium	19200			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	19.6	B		P
7440-50-8	Copper	10.9	B		P
7439-89-6	Iron	2160			P
7439-92-1	Lead	632			P
7439-95-4	Magnesium	43200			P
7439-96-5	Manganese	14600			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	24.2	B		P
7440-09-7	Potassium	1160	B		P
7782-49-2	Selenium	3.8	~~B~~ U		P
7440-22-4	Silver	2.1	B		P
7440-23-5	Sodium	1200	B		P
7440-28-0	Thallium	3.6	U		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	4180			~~NR~~ P
	Cyanide				NR

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAE60

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17274S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	101	~~B~~	U	P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	2.0	U		P
7440-39-3	Barium	65.4	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	18.8			P
7440-70-2	Calcium	18900			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	19.3	B		P
7440-50-8	Copper	11.9	B		P
7439-89-6	Iron	2110			P
7439-92-1	Lead	621			P
7439-95-4	Magnesium	43500			P
7439-96-5	Manganese	14600			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	23.8	B		P
7440-09-7	Potassium	1170	B		P
7782-49-2	Selenium	1.9	U		P
7440-22-4	Silver	3.7	B		P
7440-23-5	Sodium	1140	B		P
7440-28-0	Thallium	3.6	U		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	4260			~~NR~~ P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE61

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17275S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5850			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	98.6			P
7440-39-3	Barium	12.5	B		P
7440-41-7	Beryllium	2.6	B		P
7440-43-9	Cadmium	413			P
7440-70-2	Calcium	30300			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	126			P
7440-50-8	Copper	318			P
7439-89-6	Iron	196000			P
7439-92-1	Lead	371			P
7439-95-4	Magnesium	54900			P
7439-96-5	Manganese	41400			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	112			P
7440-09-7	Potassium	1070	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	17.1			P
7440-23-5	Sodium	3070	B		P
7440-28-0	Thallium	19.3			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc	211000			P
	Cyanide				NR

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Comments:

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INORGANIC ANALYSIS DATA SHEET

MJAE62

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17276S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	218000		J	P
7440-36-0	Antimony	199		UJ	P
7440-38-2	Arsenic	7720		J	P
7440-39-3	Barium	18.5	B		P
7440-41-7	Beryllium	37.3		J	P
7440-43-9	Cadmium	10200		J	P
7440-70-2	Calcium	146000		J	P
7440-47-3	Chromium	16.1			P
7440-48-4	Cobalt	3270		J	P
7440-50-8	Copper	11500		J	P
7439-89-6	Iron	13300000			P
7439-92-1	Lead	141		J	P
7439-95-4	Magnesium	424000		J	P
7439-96-5	Manganese	35300		J	P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	2600		J	P
7440-09-7	Potassium	147	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	1.1	U	J	P
7440-23-5	Sodium	825000		J	P
7440-28-0	Thallium	392		J	P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	18600000			P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE63

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17277S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	27100			P
7440-36-0	Antimony	28.7	~~B~~	UJ	P
7440-38-2	Arsenic	786			P
7440-39-3	Barium	10.5	B		P
7440-41-7	Beryllium	10.7			P
7440-43-9	Cadmium	2480			P
7440-70-2	Calcium	62100			P
7440-47-3	Chromium	10.5			P
7440-48-4	Cobalt	428			P
7440-50-8	Copper	1940			P
7439-89-6	Iron	2100000			P
7439-92-1	Lead	808			P
7439-95-4	Magnesium	139000			P
7439-96-5	Manganese	220000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	409			P
7440-09-7	Potassium	778	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	82.2			P
7440-23-5	Sodium	55500		J	P
7440-28-0	Thallium	155			P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	1270000			P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE64

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17278S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	505			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	13.2		u	P
7440-39-3	Barium	5.0	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	4.7	B		P
7440-70-2	Calcium	3610	B		P
7440-47-3	Chromium	1.4	B		P
7440-48-4	Cobalt	7.7	B		P
7440-50-8	Copper	7.2	B		P
7439-89-6	Iron	14300			P
7439-92-1	Lead	21.1			P
7439-95-4	Magnesium	1740	B		P
7439-96-5	Manganese	1900			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	6.2	B		P
7440-09-7	Potassium	712	B		P
7782-49-2	Selenium	1.9	U		P
7440-22-4	Silver	1.5	B		P
7440-23-5	Sodium	870	B		P
7440-28-0	Thallium	3.6	U		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	2860			~~NR~~ P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE65

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17279S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	790			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	2.0	U		P
7440-39-3	Barium	18.6	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	23.4			P
7440-70-2	Calcium	378000			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	276			P
7440-50-8	Copper	25.9			P
7439-89-6	Iron	140000			P
7439-92-1	Lead	598			P
7439-95-4	Magnesium	442000			P
7439-96-5	Manganese	326000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	251			P
7440-09-7	Potassium	17800			P
7782-49-2	Selenium	68.9			P
7440-22-4	Silver	73.3			P
7440-23-5	Sodium	4370	B		P
7440-28-0	Thallium	152			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc				~~NR~~
	Cyanide	40100			NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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INORGANIC ANALYSIS DATA SHEET

MJAE66

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17280S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20.4	U		P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	2.3	~~B~~ U		P
7440-39-3	Barium	68.3	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	18.9			P
7440-70-2	Calcium	19700			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	20.2	B		P
7440-50-8	Copper	5.6	B		P
7439-89-6	Iron	1410			P
7439-92-1	Lead	265			P
7439-95-4	Magnesium	44200			P
7439-96-5	Manganese	14800			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	24.4	B		P
7440-09-7	Potassium	1190	B		P
7782-49-2	Selenium	3.8	~~B~~ U		P
7440-22-4	Silver	2.0	B		P
7440-23-5	Sodium	1550	B		P
7440-28-0	Thallium	3.6	U		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	4180			~~NR~~ P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE67

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17281S

Level (low/med): LOW Date Received: 12/17/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	43.7	~~B~~ U		P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	2.0	U		P
7440-39-3	Barium	64.2	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	18.8			P
7440-70-2	Calcium	19300			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	19.5	B		P
7440-50-8	Copper	7.1	B		P
7439-89-6	Iron	1890			P
7439-92-1	Lead	217			P
7439-95-4	Magnesium	44000			P
7439-96-5	Manganese	14700			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	24.0	B		P
7440-09-7	Potassium	1120	B		P
7782-49-2	Selenium	1.9	U		P
7440-22-4	Silver	2.9	B		P
7440-23-5	Sodium	1300	B		P
7440-28-0	Thallium	4.5	B		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc				~~NR~~ P
	Cyanide	4510			NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

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INORGANIC ANALYSIS DATA SHEET

MJAE68

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17316S

Level (low/med): LOW Date Received: 12/18/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3210			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	60.4			P
7440-39-3	Barium	29.1	B		P
7440-41-7	Beryllium	0.97	B		P
7440-43-9	Cadmium	226			P
7440-70-2	Calcium	27500			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	76.8			P
7440-50-8	Copper	180			P
7439-89-6	Iron	95000			P
7439-92-1	Lead	429			P
7439-95-4	Magnesium	51900			P
7439-96-5	Manganese	31200			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	70.9			P
7440-09-7	Potassium	1130	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	11.0			P
7440-23-5	Sodium	1120	B		P
7440-28-0	Thallium	10.5			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc	115000			P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE69

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17317S

Level (low/med): LOW Date Received: 12/18/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3160			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	58.8			P
7440-39-3	Barium	28.3	B		P
7440-41-7	Beryllium	0.97	B		P
7440-43-9	Cadmium	225			P
7440-70-2	Calcium	27600			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	76.4			P
7440-50-8	Copper	178			P
7439-89-6	Iron	94500			P
7439-92-1	Lead	420			P
7439-95-4	Magnesium	51200			P
7439-96-5	Manganese	31200			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	72.7			P
7440-09-7	Potassium	1090	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	10.7			P
7440-23-5	Sodium	872	B		P
7440-28-0	Thallium	10.3			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc	112000			P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE70

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17318S

Level (low/med): LOW Date Received: 12/18/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	868			P
7440-36-0	Antimony	5.8	~~B~~	U	P
7440-38-2	Arsenic	124			P
7440-39-3	Barium	15.6	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	152			P
7440-70-2	Calcium	8720			P
7440-47-3	Chromium	8.2	B		P
7440-48-4	Cobalt	15.7	B		P
7440-50-8	Copper	318			P
7439-89-6	Iron	53400			P
7439-92-1	Lead	950			P
7439-95-4	Magnesium	6370			P
7439-96-5	Manganese	7100			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	16.3	B		P
7440-09-7	Potassium	1340	B		P
7782-49-2	Selenium	1.9	U		P
7440-22-4	Silver	4.0	B		P
7440-23-5	Sodium	572	B		P
7440-28-0	Thallium	5.8	B		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	32900			~~NR~~ P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE71

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17319S

Level (low/med): LOW Date Received: 12/18/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7830			P
7440-36-0	Antimony	20.0	~~B~~	UJ	P
7440-38-2	Arsenic	1130			P
7440-39-3	Barium	15.5	B		P
7440-41-7	Beryllium	4.3	B		P
7440-43-9	Cadmium	961			P
7440-70-2	Calcium	25300			P
7440-47-3	Chromium	5.0	B		P
7440-48-4	Cobalt	95.6			P
7440-50-8	Copper	587			P
7439-89-6	Iron	715000			P
7439-92-1	Lead	1700			P
7439-95-4	Magnesium	64000			P
7439-96-5	Manganese	48700			P
7439-97-6	Mercury	0.28			CV
7440-02-0	Nickel	106			P
7440-09-7	Potassium	798	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	38.3			P
7440-23-5	Sodium	6730			P
7440-28-0	Thallium	47.5			P
7440-62-2	Vanadium	2.9	U	J	P
7440-66-6	Zinc	321000			P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE72

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17320S

Level (low/med): LOW Date Received: 12/18/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	671			P
7440-36-0	Antimony	4.0	U		P
7440-38-2	Arsenic	140			P
7440-39-3	Barium	24.6	B		P
7440-41-7	Beryllium	0.60	U		P
7440-43-9	Cadmium	66.2			P
7440-70-2	Calcium	10900			P
7440-47-3	Chromium	0.90	U		P
7440-48-4	Cobalt	8.5	B		P
7440-50-8	Copper	46.6			P
7439-89-6	Iron	49900			P
7439-92-1	Lead	337			P
7439-95-4	Magnesium	12900			P
7439-96-5	Manganese	7310			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	10.0	B		P
7440-09-7	Potassium	742	B		P
7782-49-2	Selenium	1.9	U		P
7440-22-4	Silver	3.5	B		P
7440-23-5	Sodium	621	B		P
7440-28-0	Thallium	4.2	B		P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	20100			~~NR~~ P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAE73

Lab Name: SENTINEL, INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 26738 SAS No.: SDG No.: MJAE54

Matrix (soil/water): WATER Lab Sample ID: 17321S

Level (low/med): LOW Date Received: 12/18/98

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	36900			P
7440-36-0	Antimony	48.3	B		P
7440-38-2	Arsenic	4630			P
7440-39-3	Barium	11.1	B		P
7440-41-7	Beryllium	21.0			P
7440-43-9	Cadmium	4300			P
7440-70-2	Calcium	74400			P
7440-47-3	Chromium	21.0			P
7440-48-4	Cobalt	445			P
7440-50-8	Copper	3000			P
7439-89-6	Iron	3340000			P
7439-92-1	Lead	417			P
7439-95-4	Magnesium	157000			P
7439-96-5	Manganese	288000			P
7439-97-6	Mercury	0.10	B		CV
7440-02-0	Nickel	477			P
7440-09-7	Potassium	378	B		P
7782-49-2	Selenium	1.9	U	J	P
7440-22-4	Silver	93.3			P
7440-23-5	Sodium	89500		J	P
7440-28-0	Thallium	243			P
7440-62-2	Vanadium	2.9	U		P
7440-66-6	Zinc	1820000			P
	Cyanide				NR

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Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments: